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NATIONAL DAM SAFETY PROGRAM. NARRATICON LAKE DAM (NJ 00111), DE--ETC(U)
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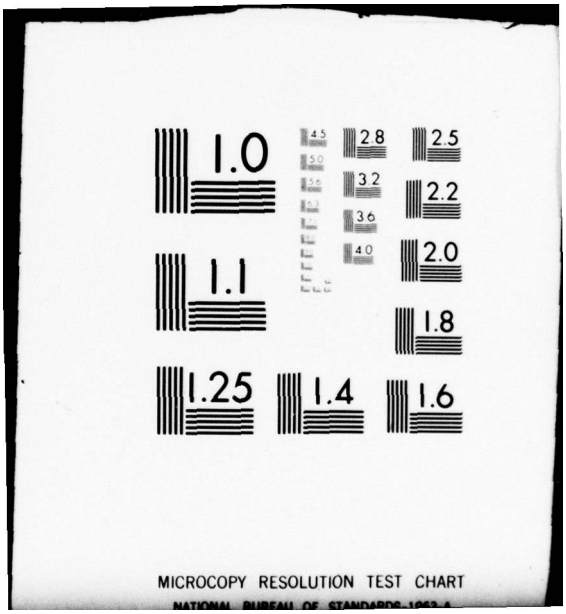
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LEVEL

DELAWARE RIVER BASIN
CHURCH RUN, GLOUCESTER COUNTY
NEW JERSEY

NARRATICON LAKE DAM NJ00111

AD A069629

PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

Approved for public release;
distribution unlimited

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

March, 1979

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National Dam Safety Program
Narraticon Lake Dam
Gloucester County, New Jersey

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Dams	National Dam Inspection Act Report
Spillways	Narraticon Lake Dam, N.J.
Structural Analysis	Safety
Visual Inspection	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

24 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Narraticon Lake Dam in Gloucester County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Narraticon Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. However, the dam's spillway is considered inadequate since 23 percent of the Spillway Design Flood-SDF-would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Initiate replacement of the deteriorated timber highway bridge within six months of the date of approval of this report.

c. Within one year, from the date of approval of this report, the following remedial actions should be completed:

NAPEN-D
Honorable Brendan T. Byrne

(1) Replace the deteriorated timber planking of the walkway over the spillway.

(2) Remove trees on the dam's embankment.

(3) Regrade and provide slope protection for the dam's embankment at the bridge wingwalls, the roadway profile low points and at the corrugated metal pipe curb drain.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Florio of the First District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

NARRATICON LAKE DAM (NJ00111)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 6 December 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The State, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Narraticon Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in fair overall condition. However, the dam's spillway is considered inadequate since 23 percent of the Spillway Design Flood-SDF-would overtop the dam. (The SDF, in this instance, is one half of the Probable Maximum Flood.) To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Initiate replacement of the deteriorated timber highway bridge within six months of the date of approval of this report.

c. Within one year, from the date of approval of this report, the following remedial actions should be completed:

(1) Replace the deteriorated timber planking of the walkway over the spillway.

(2) Remove trees on the dam's embankment.

(3) Regrade and provide slope protection for the dam's embankment at the bridge wingwalls, the roadway profile low points and at the corrugated metal pipe curb drain.

APPROVED: Jack Kelleher LTC
JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 24 May 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Narraticon Lake Dam Fed ID# NJ 00111 and ID# 484

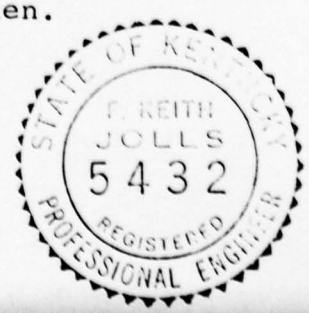
State Located New Jersey
County Located Gloucester
Coordinates Lat. 3944.8 - Long. 7518.5
Stream Church Run
Date of Inspection 6 December 1978

ASSESSMENT OF GENERAL CONDITIONS

Narraticon Lake Dam is assessed to be in a fair overall condition and is recommended to be downgraded from a high hazard to a significant hazard category. The timber spillway is deteriorated and requires replacement. No other seriously detrimental findings were uncovered. Overtopping of the highway crossing the dam would not significantly increase the danger of loss of life or property damage as the downstream flood plain is uninhabited. Remedial actions recommended to be undertaken in the future are 1) regrade and protect the downstream embankment areas at the bridge wingwalls, 2) construct slope paving on the downstream backslopes south of the roadway profile low points and 3) remove root systems on the downstream embankment slopes.

This dam has an inadequate spillway capacity, being able to accommodate only 22% of the design flood and additional hydraulic/hydrologic studies be undertaken.

F. Keith Jolls, P.E.
Project Manager



OVERVIEW OF NARRATICON LAKE DAM

December 1978

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM: NARRATICON LAKE DAM FED ID# NJ 00111

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State, in turn, is under agreement with the U.S. Army Engineer District, Philadelphia, to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Narraticon Lake Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Narraticon Lake Dam is a relatively old (45+ years) earth roadway embankment approximately 250 feet long with a timber box spillway and bridge located about 175 feet from the easterly abutment. The embankment carries Franklin Street across the entire north shore of Lake Narraticon and forms the dam structure. The three-sided timber box spillway has a total crest length of 44 feet with one section of removable flashboards 2'-3" wide. It is believed an older dam embankment predated the roadway embankment. There is a deteriorated culvert structure near

the east abutment which is part of an earlier mill works which existed below the right abutment.

b. Location

Narraticon Lake Dam is located east of the intersection of Franklin Street and Lake Avenue in the Borough of Swedesboro, Gloucester County and is built across Church Run, 0.1 mile east of the intersection of Lake Avenue and Kings Highway (Route 551).

c. Size Classification

The maximum height of the dam is 19.5 feet at the bridge structure and the maximum storage is estimated to be 370 acre-feet. Therefore, the dam is placed in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams (storage less than 1,000 acre-feet and height less than 25 feet).

d. Hazard Classification

In the event of a failure, the single appreciable economic loss could be at the Kings Highway bridge (2,000 feet downstream). Kings Highway (Route 551) is a major north-south arterial in Gloucester County. Practically all downstream residential areas are above flood elevation but a few isolated buildings could be damaged. Hence, the classification is recommended to be downgraded to significant hazard.

e. Ownership

Available records indicate the dam and appurtenant structures are owned by the Borough of Swedesboro, Borough Hall, Kings Highway, Swedesboro, 08085.

f. Purpose of Dam

The dam presently impounds a recreation lake. However, there is evidence of an old mill

site immediately downstream from the right embankment and it is believed that the dam and lake was originally constructed to provide a power source for the mill.

g. Design and Construction History

The dam in its present configuration was reconstructed in 1934 after an overtopping washed out an earlier timber bridge and part of the road. At that time, the rebuilt structure was actually erected as a temporary facility pending construction of a masonry bridge. However, the bridge was replaced in 1942 but with another timber structure and has not been modified since. In 1955 the timber box inlet was rebuilt (due to its severely deteriorated condition) from drawings filed by Charles P. Caulfield, N.J.P.E. #4879. No modifications to the timber bridge or spillway structure have been made since the 1955 reconstruction except the replacement of the removable timber flashboards. The lake has been dewatered for cleaning numerous times and it is possible that other minor repairs might have been performed. The roadway pavement has had numerous alterations including placement of guardrail, catch basin runoffs, a concrete sidewalk and asphalt resurfacing. The auxiliary spillway at the right abutment appears to be abandoned.

h. Normal Operating Procedures

There are at present no specific operating procedures at this site except periodic maintenance of the roadway and appurtenant structures (see Section 4).

1.3 PERTINENT DATA

a. Drainage Area

The drainage area: 3.0 square miles

b. Discharge of Dam Site

The spillway capacity with the reservoir at the abutment top elevation is calculated to be 1,378 cfs.

c. Elevation (above M.S.L.)

Top of dam - +22.5 (bridge deck)
Recreation Pool - +18.1
Streambed at Center Line of Dam - +3.0

d. Reservoir

Length of Recreation Pool - 3400 feet
Length of Maximum Pool - 5700 feet

e. Storage

Recreation Pool - 216 acre-ft.
Top of dam - 370 acre-ft.

f. Reservoir Surface

Top of dam - 42 acres
Recreation pool - 24 acres

g. Dam

Type - Earth embankment with timber box spillway

Length - 250 feet

Height - 19.5 feet (at bridge structure)

Freeboard between normal reservoir and top of dam - 4.4 feet

Top width - 30+ feet

Side slopes - 1½H:1V

Zoning - Unknown

h. Diversion and Regulating Tunnel

8' auxiliary spillway at old mill raceway.

i. Spillway

Type - timber box drop inlet
Length of weir - 44 feet (3 sides)
Crest Elevation - 18.1 (flashboards in place)

j. Regulating Outlets

Removable flashboards in center spillway section.

Minimum invert - +11.3 (flashboards removed)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The only information available for review was a partially legible drawing of the 1955 reconstruction work prepared by Mr. Charles Caulfield which depicted, in part, the reconstruction work on the timber spillway. No design or construction drawings were located for the earlier 1934 bridge work although it was recorded with the State Water Quality Commission (Application 247, dated November 1934). No boring data was available but soils in the vicinity are predominately sands and gravels with stratified layers of recent alluvium silts and some clay. Downstream from the dam, some organic marine deposits were observed but the terrain immediately surrounding the site appears to be of moderate natural relative density.

2.2 CONSTRUCTION

No information was available. The repair work in 1955 was filed under Application 484 by Mr. Caulfield but there are no records of the reconstruction work.

2.3 OPERATION

See Section 4

2.4 EVALUATION

a. Availability

In view of the dam assessment and recommendations contained in Section 7, it is felt sufficient engineering design data is available.

b. Adequacy

In view of the dam assessment and recommendations contained in Section 7, it is felt the field inspection provides adequate engineering data upon which to base a reliable assessment.

c. Validity

The validity of the 1955 plans is not challenged.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspection was conducted on December 6, 1978 at which time the water level in the lake was several inches below the inlet crest and afforded a close inspection of the timber bridge structure and spillway. This lower pool level had apparently been maintained since an earlier informal inspection conducted in September.

b. Dam

The roadway embankment which forms the main dam structure, was assessed to be in a solid and stable condition although pavement run-off at the gutter lines causes a continual maintenance problem, especially on the upstream side. A corrugated metal curb inlet has recently been installed just to the right of the spillway to alleviate this problem but a considerable portion of the upstream slopes in this area have been washed out. The roadway profile is on a sag vertical curve crossing over the dam and it appears there is considerable settlement in the vicinity of the CMP curb inlet. Although there are a few trees on the upstream face, the downstream backslope is heavily wooded with several larger trees. There is no evidence of riprap along the embankment structure but the backslopes have stabilizing ground cover. Heavy seepage was observed on each side of the timber bridge abutments and under the timber apron on the outlet end. This is apparently caused by piping in and around the timber structure. Additionally, other lower portions of the downstream backslope were damp which might be expected in the stratified alluvium foundation material found predominantly throughout this area. The abutment zones are ill-defined as the roadway rises up and the embankment broadens out and blends into the original terrain. The north curb line of the road is straight and is in good alignment,

the curb inlets being set at proper grade and satisfactory accommodating the street run-off.

c. Appurtenant Structures

The timber bridge and spillway structure are in poor condition and exhibit advance stages of dry rot in numerous members. The superstructure carrying traffic over the ungated outlet opening has a span of 20 feet and is founded on timber piling. The 18 by 12 foot box inlet is framed and braced solidly and is in much better condition than the bridge structure. There was only minor evidence of leaking, rotting or splintering and the stoplogs in the 2'-3" removable section are equipped with lifting eyes and appear to be operable. A considerable amount of debris had collected in the drop inlet over the summer months but is of no concern to the inspection team. The downstream wingwalls and plank outfall apron beneath the bridge are in advanced stages of decay with the left bulkhead wall tilted inward several inches. The auxiliary culvert pipe near the right abutment is set at an elevation slightly below the main spillway and although functioning satisfactory, is completely deteriorated on the inlet end and has severe cracks in its concrete headwall. This culvert outlets into an ill-defined auxiliary power raceway which extends to an old abandoned mill site about 200 feet downstream.

d. Reservoir

Lake Narraticon has stable, well protected and rather steep banks and is almost entirely surrounded by residential areas. The Lake Park Cemetary south of the dam is located well above the reservoir level. The lake was free of debris at the time of inspection.

e. Downstream Channel

After passing through the dam, Church Run flows northward approximately 1500 feet through a rather wide (300-500') marshy flood plain where it discharges into Raccoon Creek just east of Kings Highway. There are no homes in the lower flood-plain area which is quite heavily wooded. The main channel is ill-defined and quite narrow and has numerous braided auxiliary streambeds.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not observed by the inspection team. Discussions were held with Mr. Morton M. Lyons, the Borough Engineer and his earlier inspection reports on file at the N.J.D.E.P. were reviewed.

4.2 MAINTENANCE OF DAM

Maintenance of the dam is carried out as part of the Borough's continual maintenance program for their street system. The structure is periodically inspected and the reservoir dewatered and cleared approximately every other year.

4.3 MAINTENANCE OF OPERATING FACILITIES

There are no operating facilities except for the removable stoplogs.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

There is no formalized warning system in effect as the dam has not been overtopped since the early 1930's. Township engineering personnel and police monitor the structure during periods of heavy flow.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

Present procedures and safeguards are deemed to be adequate in view of its performance record and the lack of downstream hazards.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Based on the Recommended Guidelines for Safety Inspection of Dams, the Narraticon Lake Dam is small in size and of significant hazard. Accordingly, the design flood selected by the inspection team is one half the probable maximum flood (½ PMF). Inflow to the reservoir was computed utilizing precipitation data from Hydrometeorlogical Report No. 33 by the HEC-1 computer program. This gave a peak inflow to the reservoir of 6,720 cfs for the ½ PMF and when routed, the peak reduced slightly to 6,365 cfs. The spillway has a maximum discharge capacity of 1,378 cfs and based on this the spillway can accommodate 22% of the design flood.

b. Experience Data

The dam was originally designed for a 50-year frequency storm using a time of concentration of 1.8 hours. The dam was overtopped and partially washed out in July 1934 but this failure was attributed to a bridge and spillway failure. There is no record of the dam having been overtopped since this collapse and since there is no gaging station at this site, no streamflow records were available.

c. Visual Observations

The spillway opening appears to be functioning satisfactorily. At the time of the inspection, the flashboards in the main timber box were adjusted to an elevation approximately one foot above the auxiliary gate at the east abutment. However, this was during a period of low inflow and the reservoir level appears to be normally maintained at the main crest elevation. As previously stated, the auxiliary sluiceway is apparently abandoned and is partially blocked and can handle only a negligible amount of discharge.

d. Overtopping Potential

Based on a design flood of ½ PMF, there is some potential for overtopping. However the dam has not been overtopped since its reconstruction in 1934 and it would probably accommodate a 100-year event with only slight overtopping, so while the potential exists, it is not great and only of minor concern to the inspection team.

e. Drawdown Potential

The lake can only be drawn down 6.7 feet to elevation +11.4, (assuming the stop planks can be removed). Drawdown to this elevation would take approximately 2 days, assuming no appreciable inflow. There is no provision for any further dewatering.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

The timber bridge is in an advanced stage of decay and should be replaced. There is evidence of seepage in and around the entire substructure and the apron plank slab is rotted out with pieces missing and is undercut on the downstream end. The timber box spillway portion abutting the bridge is in an adequate condition to be preserved on a short-term basis but it is almost 25 years old and approaching the time for replacement for timber construction. The dam embankment is judged to be in a satisfactory and stable condition as only minor seepage was observed at the bottom of the backslopes. As previously stated, the major seepage is concentrated immediately behind the timber walls of the bridge.

b. Design and Construction Data

As no design or construction data was available to review, the structural stability analysis is based entirely on field observations. Due to its age and condition, the continued stability and safety (to vehicular traffic) of the spillway bridge is suspect.

c. Operating Records

No formal operating records exist. As previously stated, the dam appears to have operated satisfactory as there is no recent hearsay information, according to local officials and residents, of the roadway having been overtopped.

d. Post Construction Changes

There have been no changes to the hydraulic elements of the dam since the 1955 reconstruction work. Highway guardrail and curb drains

have been installed since then but have little effect on the dam stability.

e. Seismic Stability

The dam is located in Earthquake Zone 1 and has negligible damage vulnerability due to its low height. Experience indicates dams in Zone 1 will have adequate stability under dynamic loads if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Narraticon Lake Dam is classified as being in a sound condition insofar as its embankment structure is concerned but the timber spillway bridge carrying vehicular traffic over the main discharge outlet is adjudged to be in need of complete replacement. The spillway is inadequate hydraulically, being able to accommodate only 22% of the ½ PMF design flood. However, the overtopping potential is believed to be quite remote and there is minimal downstream hazard should the spillway structure collapse. Therefore, improvements to the present spillway are not recommended at this time but should be considered in the future in conjunction with the bridge replacement.

b. Adequacy of Information

The information gathered for the Phase I inspection is deemed to be adequate regarding the structural stability of the dam. However, no surveys or inspections have been recorded since 1969 and the spillway bridge has apparently undergone serious deterioration since that time.

c. Urgency

No urgency is attached to implementing further studies in view of the dam hazard assessment. It is recommended that the remedial measures enumerated below be taken under advisement in the near future or when funds are available.

d. Necessity for Further Study

Due to the significant hazard classification, further engineering studies under the purview

of the P.L. 92-367, are recommended. It is determined that the dam does not constitute a high hazard to human life or property but as previously stated, requires a replacement bridge structure to maintain through traffic and it is recommended that additional hydraulic/hydrologic studies be undertaken in an effort to increase the spillway capacity.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

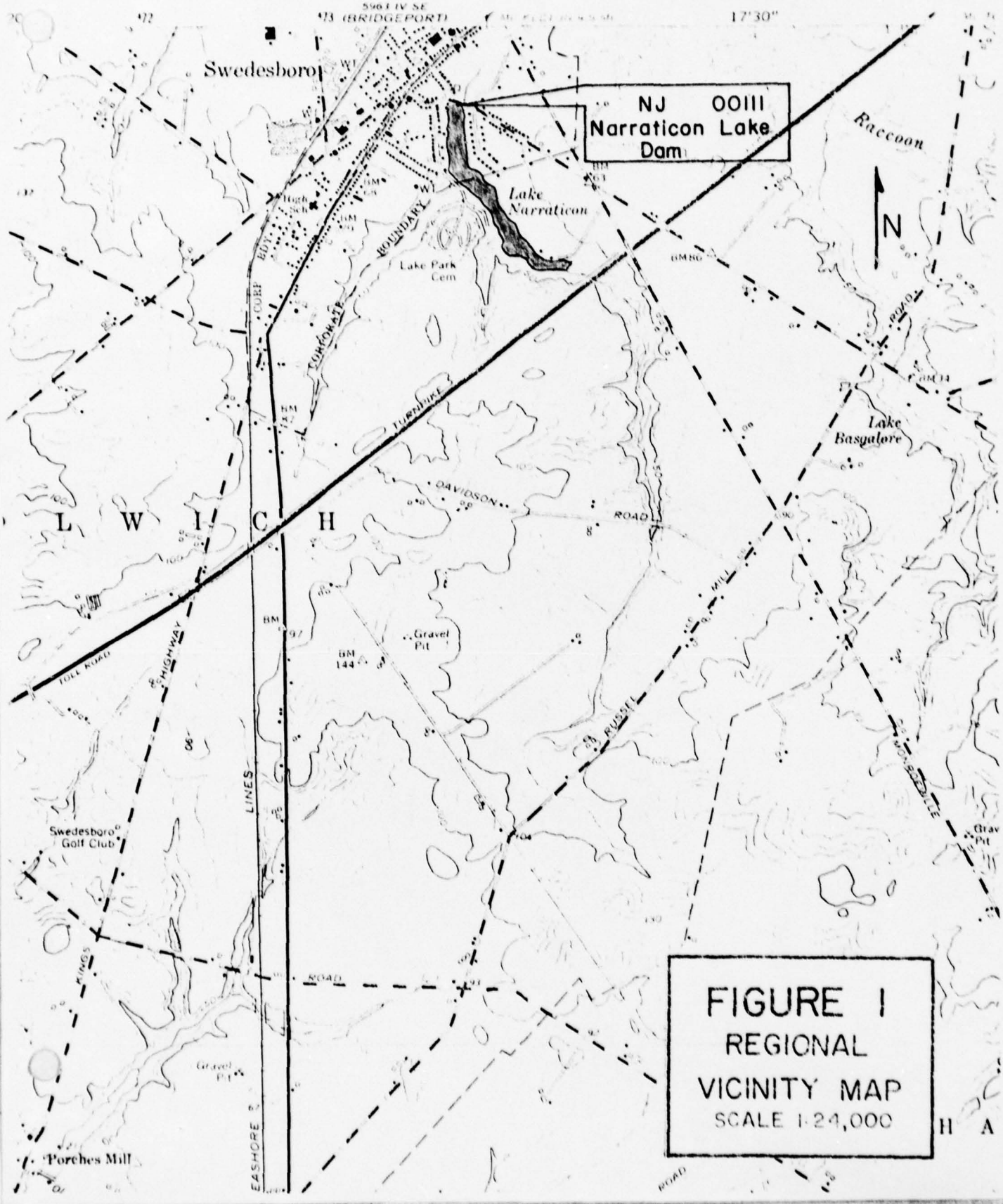
As previously stated, it is recommended that the vehicular highway bridge be replaced in the near future.

a. Remedial Measures

- The upstream slopes of the dam embankment should be regraded, compacted and protected, especially in the vicinity of the CMP curb drain.
- The trees should be removed from the dam slopes and the disturbed areas regraded, compacted and seeded.
- The deck planking on the walkway over the spillway should be replaced as it constitutes a potential danger to operating personnel.

b. O&M Maintenance and Procedures

No additional procedures other than those presently in effect appear to be warranted in view of the above assessment.


NJ 00111
Narraticon Lake
Dam
Swedesboro
Lake Narraticon
Raccoon
N
Lake Park Cem
Lake Basyatore
Gravel Pit
Swedesboro Golf Club
Porches Mill
L W I C H
H A
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

BY DL DATE 4-72

CHKD. BY DATE

SUBJECT

LOUIS BERGER & ASSOCIATES INC.

NARRAGANSETT LAKE DAM

SHEET NO. OF

PROJECT C226

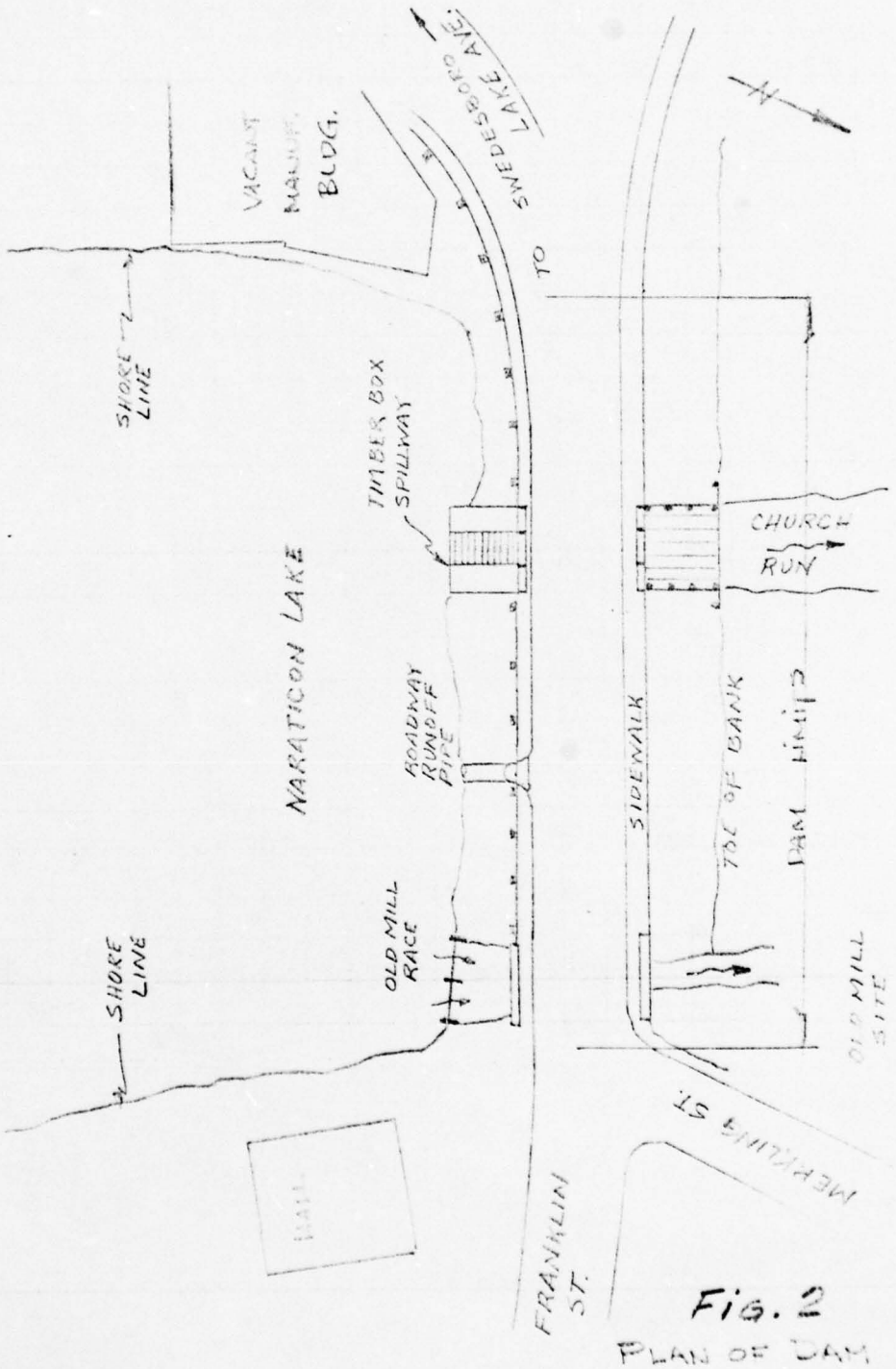


Fig. 2

PLAN OF DAM

BY DL DATE 1-77

CHKD. BY ____ DATE ____

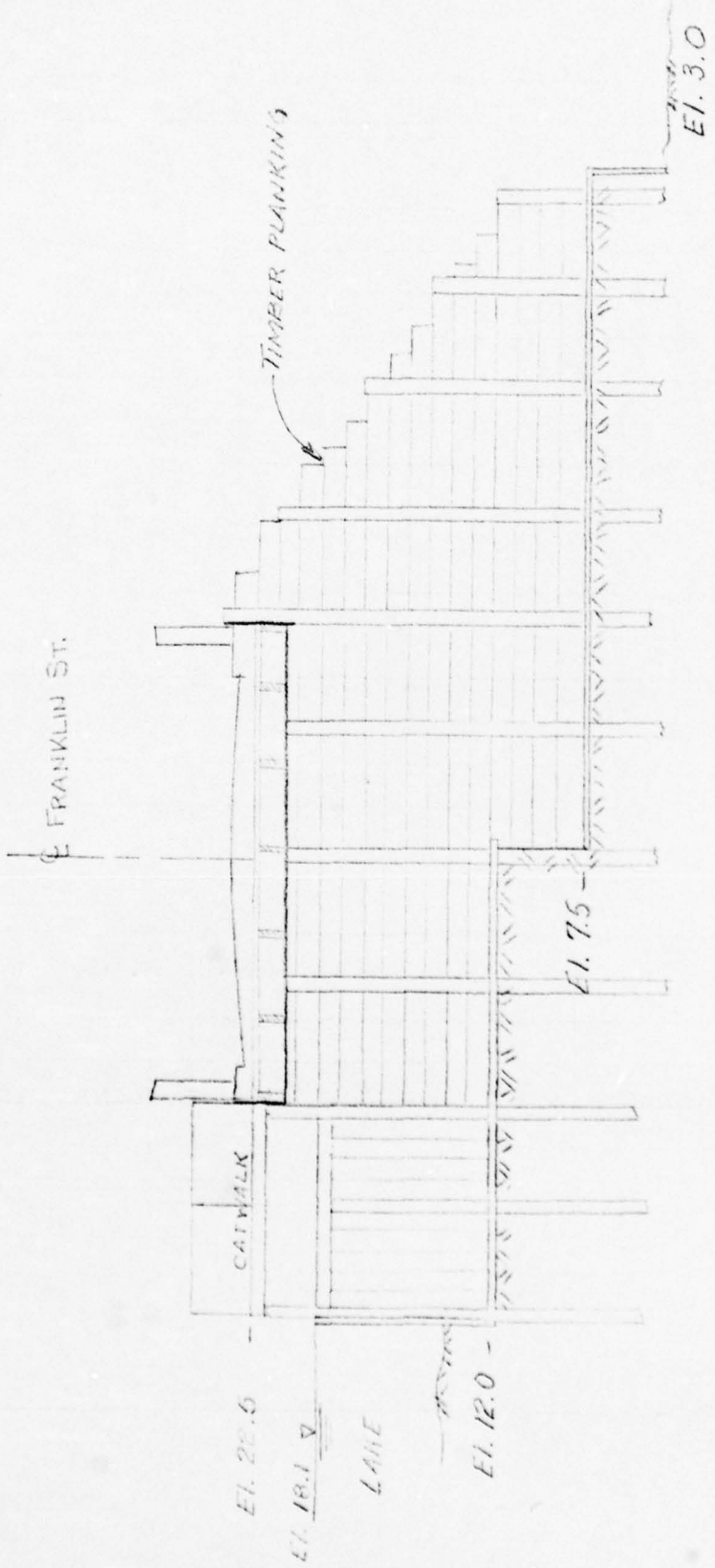
SUBJECT ____

LOUIS BERGER & ASSOCIATES INC.

NABBATUCON LAKE DAM

SHEET NO. ____ OF ____

PROJECT C-226



SECTION THRU SPILLWAY

Fig. 3

Check List
Visual Inspection
Phase 1

Name Dam Narraticon Lake Dam County Gloucester State New Jersey Coordinators NJDEP

Date(s) Inspection Dec.6, 1978 Weather Clear Temperature 35°

Pool Elevation at Time of Inspection + 16 M.S.L. Tailwater at Time of Inspection + 3 M.S.L.

Inspection Personnel:

K. Jolls E. Simone

D. Lang

M. Carter

K. Jolls Recorder

Dam No. 00111

CONCRETE/MASONRY DAMS

N/A ENTIRE STRUCTURE EARTH AND TIMBER

SUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
E PAGE ON LEAKAGE		
RUCTURE TO UTMENT/EMBANKMENT NCTIONS		
AINS		
TER PASSAGES		
UNDATION		

CONCRETE/MASONRY DAMS

N/A ENTIRE STRUCTURE EARTH AND TIMBER

ISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
RFACE CRACKS NCRETE SURFACES		
RUCTURAL CRACKING		
RTICAL AND HORIZONTAL IGNMENT		
NOLITH JOINTS		
NSTRUCTION JOINTS		

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Some at NE corner near spillway outlet washout on upstream side about 80' from spillway.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Satisfactory - top of dam is roadway on sag vertical curve with spillway at center.	
RIPRAP FAILURES	No riprap	

EMBANKMENT

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
NCTION OF EMBANKMENT D ABUTMENT, SPILLWAY D DAM	Satisfactory - roadway embankment.	
Y NOTICEABLE SEEPAGE	Bad seepage immediately each side of timber bridge walls and under spillway planking.	
AFF GAGE AND RECORDER	None	
AINS	Drains from catch basins and curb inlets into lake.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT		
INTAKE STRUCTURE	All wood structure (some minor rotting).	
OUTLET STRUCTURE	All wood structure, heavy rotting of wooden planks particularly on side walls, irregular surface from warping, 3" ø tree growing through East wall.	
OUTLET CHANNEL	Meandering natural channel heavily wooded, minor debris.	
EMERGENCY GATE	None - Old 8' wide spillway at right abutment, deteriorated concrete, west to old mill raceway, leads to 5' RCP under roadway.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Timber box	
APPROACH CHANNEL	None - lake directly above dam and spillway.	
DISCHARGE CHANNEL	Natural stream	
BRIDGE AND PIERS	Timber bridge constructed 1942, 20' span.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Steep slope 2:1 up to 10' average above spillway crest.	
SEDIMENTATION	Minor	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Some debris	
SLOPES	Approximately 200' flood plain then steep slopes up to town roads.	
APPROXIMATE NO. OF HOMES AND POPULATION	None immediately below dam. All residences and buildings well above dam crest elevation.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	None available
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Some available
TYPICAL SECTIONS OF DAM	None available
HYDROLOGIC/HYDRAULIC DATA	Some available
OUTLETS - PLAN	Available*
- DETAILS	Available*
-CONSTRAINTS	Available*
-DISCHARGE RATINGS	Available*
RAINFALL/RESERVOIR RECORDS	Some available*

*NJDEP
Trenton, N.J.

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS	Available*
HYDROLOGY & HYDRAULICS	Available*
DAM STABILITY	None available
SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS	None available
BORING RECORDS	None available
LABORATORY	None available
FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	None available
BORROW SOURCES	None available

ITEM	REMARKS
MONITORING SYSTEMS	Not available
MODIFICATIONS	Not applicable
HIGH POOL RECORDS	Not available
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Available*
PRIOR ACCIDENTS OR FAILURE OF DAM	Available*
DESCRIPTION	Not available
REPORTS	Not available
MAINTENANCE	None available
OPERATION	None available
RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN	Not available
SECTIONS	Available
DETAILS	Available
OPERATING EQUIPMENT PLANS & DETAILS	Not applicable

Spillway outlet structure

December 1978

View West of Franklin St. across dam

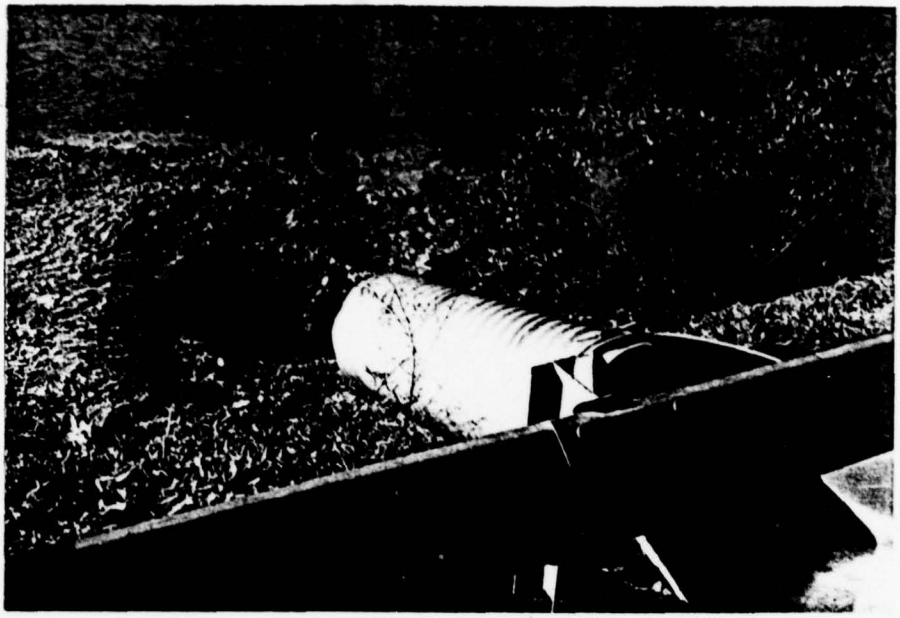
December 1978

Downstream channel

December 1978

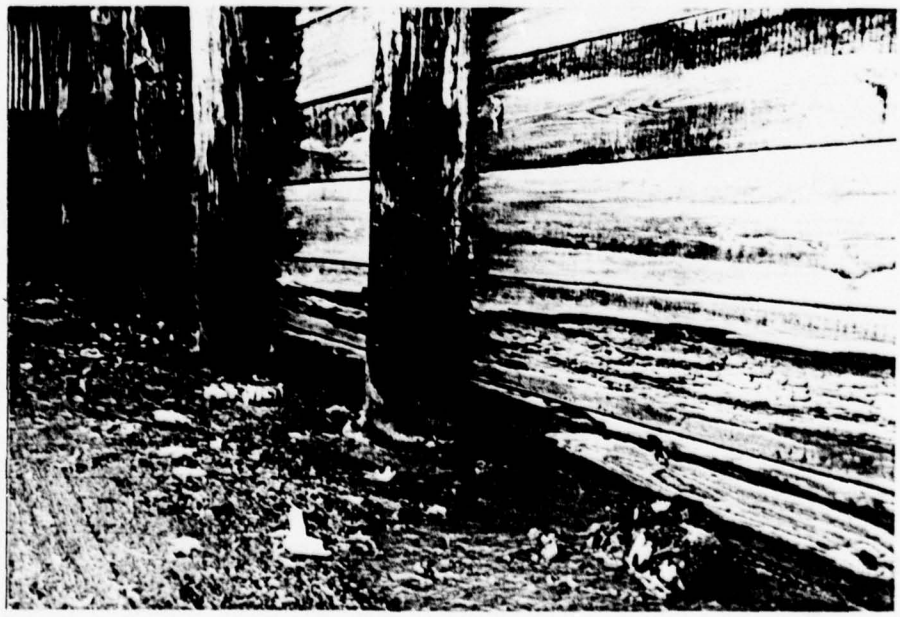
Lake Narraticon as seen from dam

December 1978



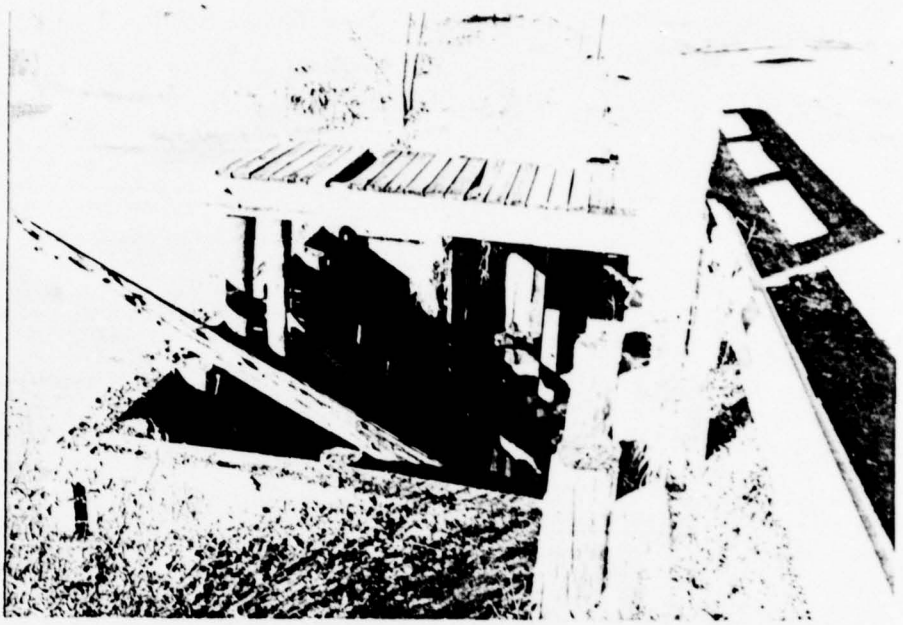
Roadway drain pipe

December 1978



Rotted timber planking in spillway structure

December 1978



Timber box spillway

December 1978

Auxillary spillway to old mill race

December 1978

Dam No. 00111

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.0 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): + 18.1 M.S.L. (216 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): + 22.5 M.S.L. (370 acre-feet)

ELEVATION MAXIMUM DESIGN POOL:

ELEVATION TOP DAM: + 22.5 M.S.L. (bridge deck)

CREST:

a. Elevation + 18.1 M.S.L.
b. Type Timber box
c. Width 8 inches
d. Length 44 feet
e. Location Spillover 125' from right abutment
f. Number and Type of Gates Removable flashboards 2'-6" wide

OUTLET WORKS:

a. Type Old power raceway weir
b. Location Right abutment
c. Entrance inverts + 16.6 M.S.L.
d. Exit inverts ---
e. Emergency draindown facilities Flashboards removed to El. + 11.3.

HYDROMETEOROLOGICAL GAGES: None

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 1378 CFS

BY D.J.M DATE 1-77 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY DATE NARRAGANSETT LAKE DAM INSPECTION PROJECT C226

SUBJECT

METHODS FOR T_c

CALIFORNIA CULVERTS METHOD

LENGTH OF WATERCOURSE $\approx$ 2.63 miles

$\Delta H \approx 100'$

$$T_c = \left(\frac{11.9 \times 2.63^3}{100}\right)^{0.385} \approx 1.4 \text{ hours}$$

FROM NOMOGRAPH (pg. 71 DESIGN OF SMALL DAMS)

$T_c \approx 1.3$ hours

U.S. NAVY & TEXAS HIGHWAY DEPARTMENT

Slope of watercourse $\approx \frac{100 \times 100}{13886} = 0.7\%$

Gives $V \approx 2$ ft s^{-1}

Gives $t \approx \frac{13886}{2 \times 3600} = 1.93$ hours

Overland flow negligible

use $T_c \approx 1.9$ hours

BY D.J.M DATE 1-79

CHKD. BY DATE

SUBJECT UNITGRAPH FOR HEC-1 INPUT

LOUIS BERGER & ASSOCIATES INC.

NARRAGANSETT LAKE DAM (DESCRIPTION)

SHEET NO. A2 OF

PROJECT C226

$$T_p = \frac{0.25}{2} + 0.6 \times 1.9 = 1.27$$

$$Q_p = \frac{454 \times 3.0 \times 1}{1.27} = 1148$$

Time	T/T_p	Dimensionless ordinate (DO)	$Q_p \times DO$
0.25	0.20	0.075	86
0.50	0.39	0.267	307
0.75	0.59	0.580	667
1.00	0.79	0.875	1004
1.25	0.98	0.990	1137
1.50	1.18	0.930	1068
1.75	1.38	0.765	878
2.00	1.57	0.590	677
2.25	1.77	0.441	506
2.50	1.97	0.335	385
2.75	2.17	0.252	289
3.00	2.36	0.192	220
3.25	2.56	0.140	161
3.50	2.76	0.1044	120
3.75	2.95	0.0808	93
4.00	3.15	0.0632	73
4.25	3.35	0.0477	55
4.50	3.54	0.0346	40
4.75	3.74	0.0274	31
5.00	3.94	0.0203	23
5.25	4.13	0.0157	18
5.50	4.33	0.0121	14

BY D.A.M. DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A3 OF

CHKD. BY _____ DATE _____ HARRIMAN LAKE DAM INSPECTION PROJECT 5227

SUBJECT PRECIPITATION DATA

PMF FOR 6 moors & 10 sq miles ≈ 27"
No adjustment for drainage area

Time	%	Precipitation	x 0.8	Δ	Rearrange Δ
0.25	18	4.86	3.89	3.89	0.43
0.50	30	8.10	6.48	2.59	0.43
0.75	41	11.07	8.86	2.38	0.43
1.00	48	12.96	10.37	1.51	0.43
1.25	54	14.58	11.66	1.29	0.43
1.50	57	15.39	12.31	0.65	0.43
1.75	62	16.74	13.39	1.08	0.43
2.00	65	17.55	14.04	0.65	0.44
2.25	67	18.09	14.47	0.43	0.44
2.50	71	19.17	15.34	0.87	0.64
2.75	74	19.98	15.98	0.64	0.87
3.00	76	20.52	16.42	0.44	1.29
3.25	78	21.06	16.85	0.43	2.59
3.50	80	21.60	17.28	0.43	3.89
3.75	82	22.14	17.71	0.43	2.38
4.00	84	22.68	18.14	0.43	1.51
4.25	86	23.22	18.58	0.44	1.08
4.50	88	23.76	19.01	0.43	0.65
4.75	90	24.30	19.44	0.43	0.65
5.00	92	24.84	19.87	0.43	0.44
5.25	94	25.38	20.30	0.43	0.43
5.50	96	25.92	20.74	0.44	0.43
5.75	98	26.46	21.17	0.43	0.43
6.00	100	27.00	21.60	0.43	0.43

BY D J M DATE 3-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A4 OF

CHKD. BY ____ DATE ____ NARRATICON LAKE DAM INSPECTION PROJECT C-226

SUBJECT Spillway discharge calculations

Effective Length of spillway @ El. 18.10 = 33.75'
" " of auxillary " @ El. 17.43 = 2 25'
@ El. 16.60 = 8.00'

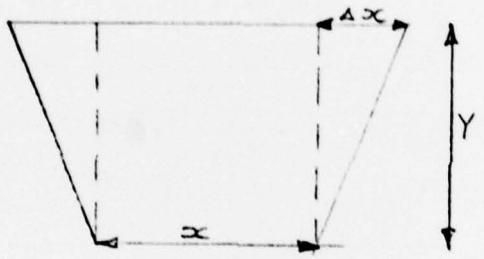
Spillway L = 33.75'			L = 225			Auxillary L = 8'			Over dam L = 206'			ΣQ (cfs)
H	C	Q	H	C	Q	H	C	Q	H	C	Q	
0.5	3.1	37	1.17	3.1	9	2.0	2.9	66				112
1.0	3.1	105	1.67	3.1	15	2.5	2.9	92				212
2.0	3.1	296	2.67	3.1	30	3.5	2.9	152				478
3.0	3.1	546	3.67	3.1	49	4.5	2.9	221				814
4.0	3.1	837	4.67	3.1	70	5.5	2.9	299				1206
4.4	3.1	966	5.07	3.1	80	5.9	2.9	332	0	2.6		1378
5.0	3.1	1170	5.67	3.1	94	6.5	2.9	384	0.6	2.6	249	1897
6.0	3.1	1538	6.67	3.1	120	7.5	2.9	477	1.6	2.6	1084	3219
7.0	3.1	1938	7.67	3.1	148	8.5	2.9	575	2.6	2.6	2245	4906
8.0	3.1	2367	8.67	3.1	178	9.5	2.9	679	3.6	2.6	3658	6882
9.0	3.1	2825	9.67	3.1	210	10.5	2.9	789	4.6	2.6	5284	9108

Spillway discharge @ top of dam = 1378 cfs

BY D.J.M DATE 4/2/79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF
CHKD. BY _____ DATE _____ (NARRATIVON LAKE DAM INSPECTION) PROJECT C226
SUBJECT _____

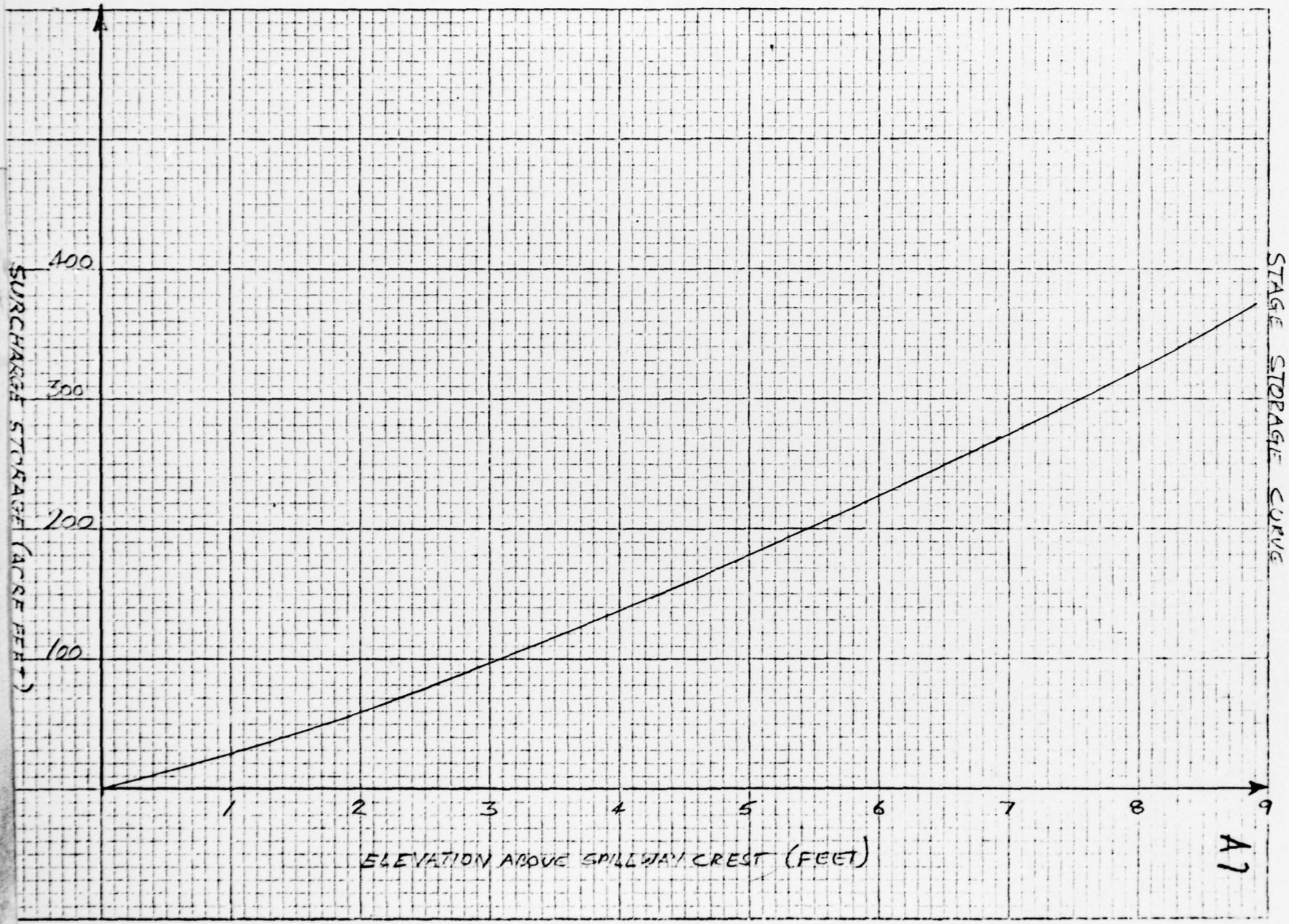
SURCHARGE STORAGE

AREA OF LAKE @ El. 18.1 = 24 acres
AREA OF CONTOUR @ El. 20.0 = 35.4 acres
AREA OF CONTOUR @ El. 30.0 = 62.8 acres



Increment in volume $\Delta V = (x + \Delta x) Y$

HEIGHT ABOVE CREST (IN FEET)	SURCHARGE STORAGE (ACRE FEET)
1	27
1.9	56
2.9	93
3.9	133
4.9	175
5.9	220
6.9	268
7.9	318
8.9	371
9.9	427
10.9	486



A7

BY D J M DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A8 OF

CHKD. BY DATE MARRATOOCK LAKE DAM INSPECTION PROJECT C226

SUBJECT APPROXIMATE DRAWDOWN CALCULATIONS

Drawdown possible with stoplanks removed between elevation 18.1 & 11.4 with effective width of 2.25'

Volume = 6.7 × AREA = 160.8 acre feet = 7004448 ft^3

Assume drawdown under average head of 3.4'

$C = 3.1$

discharge $= 2.25 \times 3.1 \times 3.4^{1.5}$

≈ 45 cfs

time to drawdown lake to El. 11.4

$$\approx \frac{7004448}{45 \times 3600} \approx 43 \text{ hours}$$

$\approx$ 2 days

Above calculation assumes no inflow to the reservoir

BY D.J.M DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A9 OF

CHKD. BY _____ DATE _____ NARRATICON LAKE DAM PROJECT C226

SUBJECT _____

NARRATICON LAKE DAM INSPECTION SOUTH GROUP C226
BY D.J.MULLIGAN
JANUARY 1979

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	15	0	0	0	0	0	0	0

JOPER	NWT
5	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1
RTIOS= 1.00 0.50 0.40 0.30 0.20 0.10

********** *********** ********** ********* **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
5	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	-1	3.00	0.0	3.00	0.0	0.0	0	0	0

PRECIP DATA

NP	STORM	DAJ	DAK
24	0.0	0.0	0.0

PRECIP PATTERN

0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.44	0.44	0.64
0.87	1.29	2.59	3.89	2.38	1.51	1.08	0.65	0.65	0.44
0.43	0.43	0.43	0.43						

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

GIVEN UNIT GRAPH, NUHGQ= 22

84.	307.	667.	1004.	1137.	1068.	878.	677.	506.	385.
289.	220.	161.	120.	93.	73.	55.	40.	31.	23.
18.	14.								

UNIT GRAPH TOTALS 7852. CFS OR 1.01 INCHES OVER THE AREA

RECESSION DATA
STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.43	0.00	0.
2	0.43	0.34	29.
3	0.43	0.40	139.

4	0.43	0.40	385.
5	0.43	0.40	770.
6	0.43	0.40	1221.
7	0.44	0.41	1659.
8	0.44	0.41	2031.
9	0.44	0.41	2325.
10	0.64	0.61	2568.
11	0.87	0.84	2825.
12	1.29	1.26	3199.
13	2.59	2.56	3896.
14	3.89	3.86	5221.
15	2.38	2.35	7311.
16	1.51	1.48	9887.
17	1.08	1.05	12179.
18	0.65	0.62	13431.
19	0.65	0.62	13448.
20	0.44	0.41	12504.
21	0.43	0.40	11084.
22	0.43	0.40	9578.
23	0.43	0.40	8207.
24	0.43	0.40	7044.
25	0.0	0.0	6076.
26	0.0	0.0	5222.
27	0.0	0.0	4405.
28	0.0	0.0	3600.
29	0.0	0.0	2840.
30	0.0	0.0	2176.
31	0.0	0.0	1642.
32	0.0	0.0	1233.
33	0.0	0.0	924.
34	0.0	0.0	686.
35	0.0	0.0	494.
36	0.0	0.0	332.
37	0.0	0.0	228.
38	0.0	0.0	159.
39	0.0	0.0	110.
40	0.0	0.0	77.
41	0.0	0.0	51.
42	0.0	0.0	35.
43	0.0	0.0	22.
44	0.0	0.0	13.
45	0.0	0.0	6.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
51	0.0	0.0	0.
52	0.0	0.0	0.
53	0.0	0.0	0.
54	0.0	0.0	0.
55	0.0	0.0	0.
56	0.0	0.0	0.
57	0.0	0.0	0.
58	0.0	0.0	0.
59	0.0	0.0	0.
60	0.0	0.0	0.
61	0.0	0.0	0.
62	0.0	0.0	0.
63	0.0	0.0	0.
64	0.0	0.0	0.

65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.
68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.
72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
101	0.0	0.0	0.
102	0.0	0.0	0.
103	0.0	0.0	0.
104	0.0	0.0	0.
105	0.0	0.0	0.
106	0.0	0.0	0.
107	0.0	0.0	0.
108	0.0	0.0	0.
109	0.0	0.0	0.
110	0.0	0.0	0.
111	0.0	0.0	0.
112	0.0	0.0	0.
113	0.0	0.0	0.
114	0.0	0.0	0.
115	0.0	0.0	0.
116	0.0	0.0	0.
117	0.0	0.0	0.
118	0.0	0.0	0.
119	0.0	0.0	0.
120	0.0	0.0	0.
121	0.0	0.0	0.
122	0.0	0.0	0.
123	0.0	0.0	0.
124	0.0	0.0	0.
125	0.0	0.0	0.

BY D.J.M. DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A12 OF

CHKD. BY ______ DATE ________ NARRATICON LAKE DAM PROJECT ____________

SUBJECT ____________

126	0.0	0.0	0.
127	0.0	0.0	0.
128	0.0	0.0	0.
129	0.0	0.0	0.
130	0.0	0.0	0.
131	0.0	0.0	0.
132	0.0	0.0	0.
133	0.0	0.0	0.
134	0.0	0.0	0.
135	0.0	0.0	0.
136	0.0	0.0	0.
137	0.0	0.0	0.
138	0.0	0.0	0.
139	0.0	0.0	0.
140	0.0	0.0	0.
141	0.0	0.0	0.
142	0.0	0.0	0.
143	0.0	0.0	0.
144	0.0	0.0	0.
145	0.0	0.0	0.
146	0.0	0.0	0.
147	0.0	0.0	0.
148	0.0	0.0	0.
149	0.0	0.0	0.
150	0.0	0.0	0.
SUM	21.61	20.43	161272.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13448.	6363.	1680.	1075.	161272.
INCHES		19.73	20.84	20.84	20.84
AC-FT		3157.	3334.	3334.	3334.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 1

0.	29.	139.	385.	770.	1221.	1659.	2031.	2325.	2568.
2825.	3199.	3896.	5221.	7311.	9887.	12179.	13431.	13448.	12504.
11084.	9578.	8207.	7044.	6076.	5222.	4405.	3600.	2840.	2176.
1642.	1233.	924.	686.	494.	332.	228.	159.	110.	77.
51.	35.	22.	13.	6.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	13448.	6363.	1680.	1075.	161272.
INCHES		19.73	20.84	20.84	20.84
AC-FT		3157.	3334.	3334.	3334.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 2

0.	15.	69.	193.	385.	611.	830.	1015.	1162.	1284.
1412.	1599.	1948.	2611.	3655.	4943.	6089.	6716.	6724.	6252.
5542.	4789.	4103.	3522.	3038.	2611.	2203.	1800.	1420.	1088.
821.	617.	462.	343.	247.	166.	114.	79.	55.	38.
26.	17.	11.	6.	3.	0.	0.	0.	0.	0.

BY D.J.M DATE 4-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A13 OF

CHKD. BY ______ DATE ________ NARRATICON LAKE DAM PROJECT ________

SUBJECT ________

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6724.	3182.	840.	538.	80636.
INCHES		9.87	10.42	10.42	10.42
AC-FT		1578.	1667.	1667.	1667.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 3

0.	12.	56.	154.	308.	489.	664.	812.	930.	1027.
1130.	1280.	1558.	2089.	2924.	3955.	4871.	5372.	5379.	5002.
4434.	3831.	3283.	2818.	2430.	2089.	1762.	1440.	1136.	870.
657.	493.	370.	275.	197.	133.	91.	64.	44.	31.
20.	14.	9.	5.	2.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5379.	2545.	672.	430.	64509.
INCHES		7.89	8.33	8.33	8.33
AC-FT		1263.	1334.	1334.	1334.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 4

0.	9.	42.	116.	231.	366.	498.	609.	697.	770.
847.	960.	1169.	1566.	2193.	2966.	3654.	4029.	4034.	3751.
3325.	2873.	2462.	2113.	1823.	1567.	1322.	1080.	852.	653.
493.	370.	277.	206.	148.	100.	68.	48.	33.	23.
15.	10.	7.	4.	2.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4034.	1909.	504.	323.	48382.
INCHES		5.92	6.25	6.25	6.25
AC-FT		947.	1000.	1000.	1000.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 5

BY D. J. M. DATE 4-79

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A14 OF

CHKD. BY ______ DATE ________

NARRATICON LAKE DAM

PROJECT ____________

SUBJECT ____________

0.	6.	28.	77.	154.	244.	332.	406.	465.	514.
565.	640.	779.	1044.	1462.	1977.	2436.	2686.	2690.	2501.
2217.	1916.	1641.	1409.	1215.	1044.	881.	720.	568.	435.
328.	247.	185.	137.	99.	66.	46.	32.	22.	15.
10.	7.	4.	3.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2690.	1273.	336.	215.	32254.
INCHES		3.95	4.17	4.17	4.17
AC-FT		631.	667.	667.	667.

HYDROGRAPH AT STA 5 FOR PLAN 1, RTIO 6

0.	3.	14.	39.	77.	122.	166.	203.	232.	257.
282.	320.	390.	522.	731.	989.	1218.	1343.	1345.	1250.
1108.	958.	821.	704.	608.	522.	441.	360.	284.	218.
164.	123.	92.	69.	49.	33.	23.	16.	11.	8.
5.	3.	2.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1345.	636.	168.	108.	16127.
INCHES		1.97	2.08	2.08	2.08
AC-FT		316.	333.	333.	333.

HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
55	1	0	0	0	0	1

ROUTING DATA

QLOSS	CLOSS	AVG.	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE=	0.	60.	97.	138.	180.	226.	272.	322.	378.	0.
OUTFLOW=	0.	478.	814.	1206.	1897.	3219.	4906.	6882.	9108.	0.

BY D.J.M. DATE 4-71 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A15 OF.

CHKD. BY _____ DATE _____ NARRAGANSETT LAKE DAM PROJECT _____

SUBJECT _____

STATION 55, PLAN 1, RTIO 1

0.	2.	15.	52.	132.	263.	442.	679.	942.	1216.
1646.	2127.	2777.	3668.	5106.	7132.	9403.	11384.	12581.	12811.
12219.	11120.	9823.	8544.	7389.	6378.	5471.	4634.	3857.	3133.
2573.	2053.	1713.	1449.	1202.	1060.	920.	790.	678.	578.
490.	420.	361.	309.	263.	223.	189.	161.	136.	116.
98.	83.	70.	60.	51.	43.	36.	31.	26.	22.
19.	16.	14.	11.	10.	8.	7.	6.	5.	4.
4.	3.	3.	2.	2.	2.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	2.	7.	17.	33.	56.	82.	110.	139.
165.	188.	211.	238.	277.	328.	385.	435.	465.	471.
456.	429.	396.	364.	335.	309.	286.	265.	243.	223.
204.	185.	169.	153.	138.	123.	108.	94.	82.	71.
61.	53.	45.	39.	33.	28.	24.	20.	17.	14.
12.	10.	9.	7.	6.	5.	5.	4.	3.	3.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12811.	6208.	1680.	1075.	161270.
INCHES		19.25	20.84	20.84	20.84
AC-FT		3080.	3334.	3334.	3334.

STATION 55, PLAN 1, RTIO 2

0.	1.	7.	26.	66.	132.	221.	328.	444.	573.
706.	845.	1012.	1260.	1804.	2893.	4270.	5471.	6195.	6365.
6094.	5556.	4912.	4308.	3743.	3238.	2854.	2464.	2073.	1771.
1534.	1297.	1126.	996.	870.	754.	648.	554.	471.	407.
350.	300.	256.	219.	186.	158.	134.	114.	96.	82.
69.	59.	50.	42.	36.	30.	26.	22.	19.	16.
13.	11.	10.	8.	7.	6.	5.	4.	4.	3.
3.	2.	2.	2.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	1.	3.	8.	17.	28.	41.	56.	70.
85.	100.	118.	141.	174.	215.	255.	286.	305.	309.
302.	288.	272.	256.	240.	227.	213.	200.	186.	172.

BY D. J. M. DATE 4-71 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A16 OF

CHKD. BY ______ DATE ______ NARRATICON LAKE DAM PROJECT ______

SUBJECT ______

158.	144.	130.	116.	103.	90.	79.	68.	59.	51.
44.	38.	32.	27.	23.	20.	17.	14.	12.	10.
9.	7.	6.	5.	4.	4.	3.	3.	2.	2.
2.	1.	1.	1.	1.	1.	1.	1.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6365.	3040.	840.	538.	80634.
INCHES		9.42	10.42	10.42	10.42
AC-FT		1508.	1667.	1667.	1667.

STATION 55, PLAN 1, RTIO 3

0.	1.	6.	21.	53.	105.	177.	262.	355.	450.
554.	666.	795.	979.	1283.	1917.	3060.	4161.	4829.	5034.
4854.	4457.	3963.	3461.	3037.	2681.	2335.	1999.	1755.	1537.
1312.	1139.	1012.	888.	773.	668.	573.	488.	421.	363.
311.	267.	228.	194.	165.	140.	119.	101.	86.	73.
61.	52.	44.	37.	32.	27.	23.	19.	16.	14.
12.	10.	8.	7.	6.	5.	4.	4.	3.	3.
2.	2.	2.	1.	1.	1.	1.	1.	1.	1.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	1.	3.	7.	13.	22.	33.	45.	56.
68.	81.	95.	114.	143.	181.	220.	252.	270.	275.
271.	260.	246.	233.	220.	207.	195.	184.	171.	158.
144.	131.	118.	105.	92.	81.	70.	61.	53.	46.
39.	33.	29.	24.	21.	18.	15.	13.	11.	9.
8.	7.	6.	5.	4.	3.	3.	2.	2.	2.
1.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	5034.	2414.	672.	430.	64509.
INCHES		7.48	8.33	8.33	8.33
AC-FT		1197.	1334.	1334.	1334.

STATION 55, PLAN 1, RTIO 4

0.	1.	4.	16.	40.	79.	133.	197.	266.	337.
409.	485.	584.	719.	923.	1230.	1834.	2717.	3339.	3643.
3586.	3318.	3004.	2676.	2352.	2051.	1818.	1639.	1443.	1243.

BY D.J.M DATE 4-79 | **LOUIS BERGER & ASSOCIATES INC.** | SHEET NO. A17 OF
CHKD. BY ______ DATE ______ NARRATICON LAKE DAM | PROJECT ______
SUBJECT ______

1108.	987.	867.	758.	658.	566.	484.	418.	361.	310.
266.	227.	194.	165.	141.	119.	101.	86.	73.	62.
52.	44.	38.	32.	27.	23.	19.	16.	14.	12.
10.	9.	7.	6.	5.	4.	4.	3.	3.	2.
2.	2.	1.	1.	1.	1.	1.	1.	1.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	1.	2.	5.	10.	17.	25.	33.	42.
51.	61.	72.	87.	108.	139.	176.	209.	229.	238.
236.	229.	219.	207.	196.	185.	175.	164.	152.	140.
128.	115.	103.	91.	80.	70.	61.	53.	45.	39.
33.	29.	24.	21.	18.	15.	13.	11.	9.	8.
7.	6.	5.	4.	3.	3.	2.	2.	2.	1.
1.	1.	1.	1.	1.	1.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3643.	1794.	504.	323.	48381.
INCHES		5.56	6.25	6.25	6.25
AC-FT		890.	1000.	1000.	1000.

STATION 55, PLAN 1, RTIO 5

0.	0.	3.	10.	26.	53.	88.	131.	177.	225.
273.	323.	382.	462.	596.	789.	1042.	1383.	1762.	2066.
2200.	2139.	1974.	1815.	1669.	1512.	1353.	1198.	1098.	991.
881.	776.	680.	591.	510.	441.	383.	330.	284.	244.
209.	178.	152.	129.	110.	93.	79.	67.	57.	48.
41.	35.	29.	25.	21.	18.	15.	13.	11.	9.
8.	7.	6.	5.	4.	3.	3.	2.	2.	2.
2.	1.	1.	1.	1.	1.	1.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	0.	1.	3.	7.	11.	16.	22.	28.
34.	41.	48.	58.	73.	94.	121.	149.	172.	186.
191.	188.	183.	175.	166.	157.	147.	137.	127.	115.
104.	93.	82.	72.	64.	55.	48.	41.	36.	31.
26.	22.	19.	16.	14.	12.	10.	8.	7.	6.
5.	4.	4.	3.	3.	2.	2.	2.	1.	1.
1.	1.	1.	1.	1.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2200.	1180.	336.	215.	32254.
INCHES		3.66	4.17	4.17	4.17
AC-FT		585.	667.	667.	667.

STATION 55, PLAN 1, RTIO 6

0.	0.	1.	5.	13.	26.	44.	66.	89.	112.
136.	161.	191.	231.	291.	378.	489.	625.	748.	844.
904.	927.	921.	892.	850.	799.	745.	686.	623.	559.
496.	440.	390.	343.	300.	260.	225.	194.	166.	142.
122.	104.	89.	75.	64.	54.	46.	39.	33.	28.
24.	20.	17.	15.	12.	10.	9.	8.	6.	5.
5.	4.	3.	3.	2.	2.	2.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

STOR

0.	0.	0.	1.	2.	3.	6.	8.	11.	14.
17.	20.	24.	29.	37.	47.	61.	76.	90.	100.
106.	109.	108.	105.	101.	95.	89.	83.	76.	69.
62.	55.	49.	43.	38.	33.	28.	24.	21.	18.
15.	13.	11.	9.	8.	7.	6.	5.	4.	4.
3.	3.	2.	2.	2.	1.	1.	1.	1.	1.
1.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	927.	582.	168.	108.	16127.
INCHES		1.80	2.08	2.08	2.08
AC-FT		289.	333.	333.	333.

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS 1.00	0.50	0.40	0.30	0.20	0.10
HYDROGRAPH AT	5	1	13448.	6724.	5379.	4034.	2690.	1345.
		2	0.	0.	0.	0.	0.	0.
ROUTED TO	55	1	12811.	6365.	5034.	3643.	2200.	927.
		2	0.	0.	0.	0.	0.	0.